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Diversity of the ground inhabiting ant fauna at Department of Atomic Energy campus, Kalpakkam (Tamil Nadu)

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Abstract

Ant sampling was carried out in different locations of the Department of Atomic Energy (DAE) Campus at Kalpakkam during dry season (March – June 2008). Pit-fall traps and hand-picking methods were used to collect ants from 20 different sampling sites. A total of 31 species, 15 genera, and 5 subfamilies of ants were collected. The Myrmicinae were the most common, with 7 genera and 16 species, followed by the Formicinae (4 genera and 8 species), the Ponerinae (2 genera and 2 species), the Pseudomyrmecinae (1 genus and 4 species) and the Dolichoderinae was represented by only 1 species. Interestingly 86.6% of the genera, 83.8% of the species, and 92.4% of the individuals collected belonged to three subfamilies (Myrmicinae, Ponerinae, and Formicinae). The five most species-rich genera were *Monomorium*, *Camponotus*, *Tetraponera*, *Crematogaster* and *Tetramorium*. The taxonomic structure of the myrmecofauna sampled, resembles that of Western and Eastern Ghats and other tropical regions in two ways: Firstly, many rare species and a few abundant species: Secondly, the dominance of subfamilies such as Myrmicinae, Ponerinae and Formicinae. The species accumulation curve indicated that the likelihood of getting more number of species in DAE campus and this finding was supported by rarefaction curve

Keywords: *Ant diversity, Ground-inhabiting ants, Pit-fall trap, DAE Campus, Kalpakkam.*

Introduction

The use of indicator taxa, i.e. taxa that are theoretically representative of other taxa at a given site, has become important in studies of biodiversity in light of the need for rapid, reliable and cost-effective assessments that can be used in conservation and monitoring programs (Oliver and Beattie, 1993 and Kerr *et al.*, 2000). Determining the level of diversity of these groups should permit predictions about the other taxa to be present (Pearson and Carroll 1998, Lawton *et al.*,1998, Lindenmayer, 1999 and Kerr *et al.*, 2000).Traditionally, majority of studies used vascular plants and vertebrates as indicator taxa (Agosti and Alonso, 2000). However, recently the importance and appropriateness of using invertebrate groups have been recognized (Pearson, 1994, Oliver and Beattie, 1996a and 1996b). Ants in particular are an excellent choice for use as an indicator taxon (Longino and Colwell, 1997 and Agosti and Alonso, 2000) due to their high local diversity, numerical and biomass dominance in almost every terrestrial habitat. Moreover, their important functions in ecosystems, organization in communities that are sensible to variations in the environment, relatively good base of taxonomic knowledge, and ease of sampling (Carroll and Janzen, 1973, Holldobler and Wilson, 1990, Bestelmeyer *et al.,* 2000, Brown, 2000 and Schultz and McGlynn 2000) are also responsible for their choice as indicator species. Ground-inhabiting ants are particularly promising group as they represent a large portion of the myrmecofauna. The ant fauna of India remains relatively unexplored (Rastogi *et al.,* 1997). Barring a few isolated studies, very little information is available on ants in India, especially bio-ecology and their usefulness as bioindicators of environmental health. Site-specific reports are essential because biodiversity profile varies regionally. Studies on ant faunal diversity in Tamil Nadu still remains rudimentary. Hence, an attempt was made to study the diversity pattern of ground inhabiting ant fauna of DAE Campus at Kalpakkam, Tamil Nadu. This exercise assumes greater significance considering the fact that DAE campus is going to be a nuclear complex soon. Thus, it in imperative to take stock of present biodiversity status for future impact assessment studies.

Materials and Methods

Study area

The DAE campus at Kalpakkam encompasses seashore and a vast plain area of the Bay of Bengal. The coastal system forms the complex natural site where intense interactions occur among land, sea and atmosphere.The unique interaction throws biological consortia peculiar to this system. It spreads through the biologically diverse and productive habitat for native flora and fauna and aesthetically blended with introduced vegetation. All the study sites were located inside the DAE campus. Totally 20 representative sampling sites comprising of different landscapes viz., undisturbed scrub jungle, near water bodies, riparian woods, sandy area, casurina monoculture, area with meagre native vegetation and building area (Fig.1) were selected for the study.

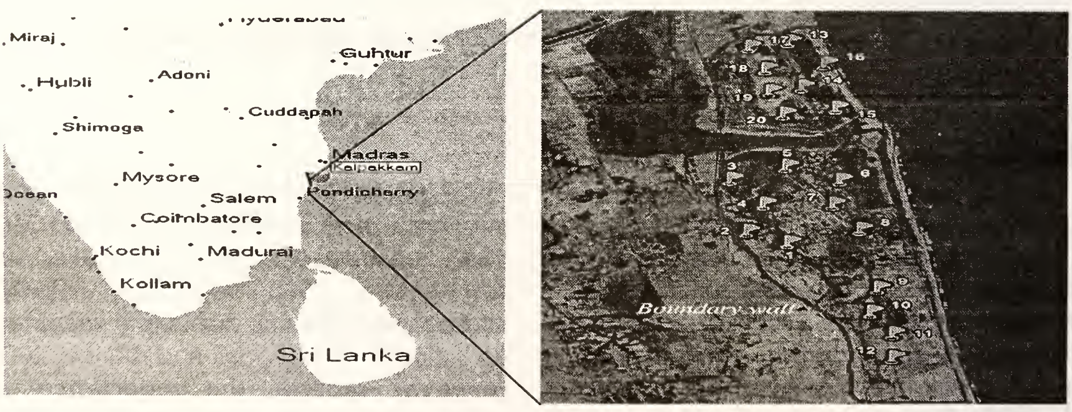

Fig.1: Map showing study area and sampling locations

Methodology

Ant sampling was carried out in different locations of the DAE Campus during dry season (March – June 2008). Pit-fall traps and hand-picking methods were used to collect ants in different sampling sites. Pit-fall trapping method permits foraging workers to be captured and provides information on the species present in the sampling area. The trap consisted of a one-liter plastic jar with an opening of 7cm in diameter and was placed at ground level. Six pit-fall traps were installed in a more or less straight transect line with each trap approximately 10mtrs apart. Each jar carried 25 ml of 0.05% methyl parathion. The traps were set up between 15.00 and 17.00 hrs and were collected on the next day evening. Ants trapped in the jars were preserved in labelled containers of 70% alcohol. In addition to trapping method described above, an intensive all-out-search to physically collect representative of as many species of ants as possible was made in each sampling unit. In hand-picking collection, two observers walked randomly around each transects (site viz) and to the extent possible, the effort involved in this process was kept same. Ants associated with leaf litter were also collected qualitatively to cover overall species spectrum, quantitative collection method was not preformed because leaf litter was not available at many locations in sandy area of the campus. No attempt was made to estimate abundance by these methods. Data collected through pit-fall was taken to quantify abundance. Collected ant species samples were identified primarily based on Bolton (1995) and Fauna of British India, Bingham (1903). Some specimens were sent to specialist to confirm their identity.

Results

Taxonomic structure of the fauna

A total of 31 species, 15 genera, and 5 subfamilies of ants were collected. The Myrmicinae were the most common, with 7 genera and 16 species, followed by the Formicinae (4 genera and 8 species), the Ponerinae (2 genera and 2 species), the Pseudomyrmicinae (1 genus, 4 species) and the Dolichoderinae was represented by only one species. Interestingly 86.6% of the genera, 83.8% of the species, and 92.4% of the individuals collected belonged to three subfamilies (Myrmicinae, Ponerinae, Formicinae) (Table-1).

Table-1: Total number and percentage of species, genera, and individuals collected per subfamily.

Subfamily	Genera		Species		Individuals	
	No.	%	No.	%	No.	%
Formicinae	4	26.67	8	25.81	214.00	17.88
Myrmicinae	7	46.67	16	51.61	658.00	54.97
Ponerinae	2	13.33	2	6.45	234.00	19.55
Pseudomyrmecinae	1	6.67	4	12.90	15.00	1.25
Dolichoderinae	1	6.67	1	3.23	76.00	6.35
Total (5)	15	100	31	100	1197	100

The five most species-rich genera were *Monomorium* (5 sp.), *Camponotus* (4 sp.), *Tetraponera* (4 sp.), *Crematogaster* (3 sp.) and *Tetramorium* (3 sp.). Out of 15 genera recorded these five genera collectively contribute 70.28% of total species encountered (Table-2). Twenty one species could be identified to the species level: *Diacamma rugosum, Camponotus variegates, Solenopsis invicta, Crematogaster subnuda, Tapinoma melanocephalum, Myrmicaria brunnea, Camponotus sericeus, Pachycondyla sulcata, Plagiolepis longipes, Monomorium scabriceps, Monomorium floricola, Paratrechina longicornis, Oecophylla smaragdina, Monomorium destructor, Camponotus compressus, Monomorium latinode, Pheidole latinoda, Tetraponera rufonigra, Meranoplus bicolor, Tetraponera nigra, Tetramorium walshi.*

Patterns in species richness

The number of ant species found in each

Table–2: Species richness of genera.

Subfamily	Genera	Species	
		No.	%
Formicinae	*Camponotous*	4	12.90
	Oecophylla	1	3.23
	Paratrechina	2	6.45
	Plagiolepis	1	3.23
Myrmicinae	*Crematogaster*	3	9.68
	Meranoplus	1	3.23
	Monomorium	5	16.13
	Myrmicaria	1	3.23
	Pheidole	2	6.45
	Solenopsis	1	3.23
	Tetramorium	3	9.68
Ponerinae	*Diacamma*	1	3.23
	Pachycondyla	1	3.23
Dolichoderinae	*Tapinoma*	1	3.23
Pseudomyrmecinae	*Tetraponera*	4	12.90
Total		31	100

sampling unit varied from six to ten in most samples, with an average of eight (Fig.2). In the first sampling unit itself, 13 species were encountered. To know the accumulation pattern and area vs. species relationship, species accumulation curve was plotted. The graph (Fig. 3), indicated increase in record of new species with the increase in sampling attempts. More than 60% of the species were recorded at 8th sampling effort and even at 9th sampling attempt the graph showed increasing trend which clearly indicated the possibility of getting more species.

Michaelis-Menten type model describes well about the accumulation of species records as the number of sampling attempt increases. This model has clearly demonstrated that, with increase in sampling attempts the likelihood of adding new species is most likely. Fig-4. depicts the rarefaction curve using MMMean and Coleman curve estimators of species richness. Michaelis-Menten model and Coleman curve were used for sampling data after randomizing them 50 times using the procedure of Colwell (1997). This indicated that the sampling area was rich enough to fetch 44 speices and as the average for all sites was 34 species.

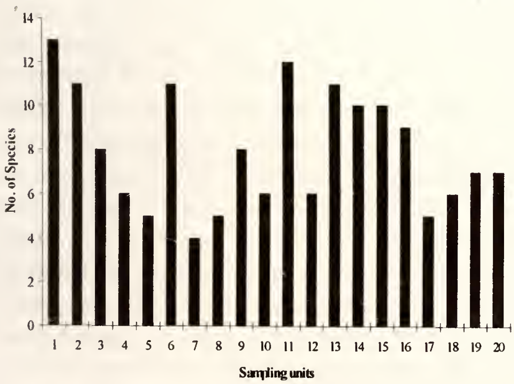

Fig.2: Distribution of number of species encountered in each sampling unit.

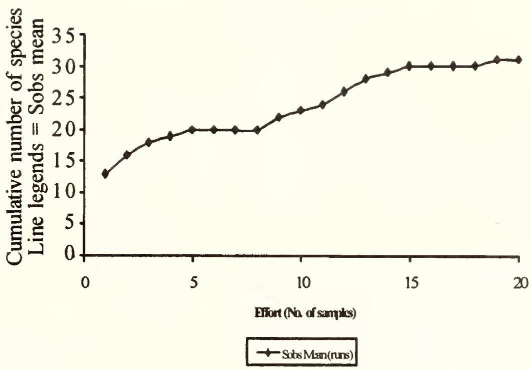

Fig.3: Species accumulation curve.

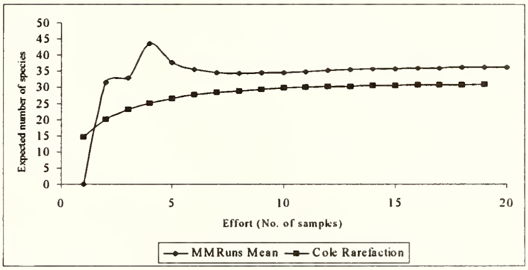

Fig.4: Rarefaction curves of performance of Michaelis-Menten richness estimators (MM Mean) and Coleman curve as a function of randomized sample accumulation.

Pattern in species abundance profile

The number of individuals trapped in pit-fall ranged from 24 to 142 with an average of 60 (Fig.5). Abundance was high at sampling sites 1, 11 and 14 because certain common species Viz., *Diacamma rugosum, Camponotus variegates, Myrmicaria brunnea, Pheidole* spp. dominated those sites. When the relative abundance of species was plotted against the rank, the plot often lead to approximately straight line. The more horizontal the line, the more equitable the distribution. In the present case rank order abundance plot demonstrated that a small number of very abundant species and a large number of rare species were captured (Fig.6).

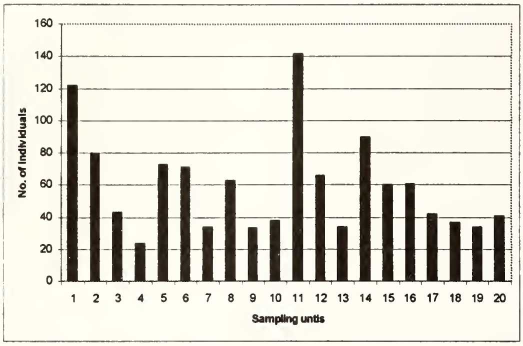

Fig.5: Abundance profile of ants collected at different sampling units at DAE campus.

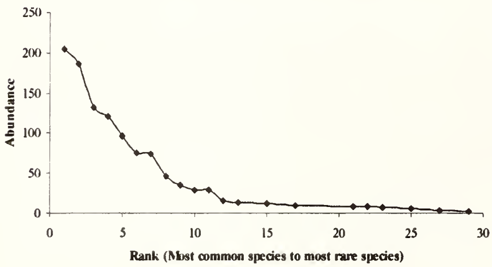

Fig.6: Rank order abundance plot of ant fauna at Kalpakkam.

Discussion

The results indicate that the diversity of the ground-inhabiting ant fauna of DAE campus was relatively high (31 species and 15 genera), as compared to that of other regions of Tamil Nadu with a similar sampling effort and methodology (Vinodhini *et al.,* 2003, Rajagopal *et al.,* 2005, Kaleeswaran, 2006 and Ramesh, 2007). Where as comparatively high diversity was reported from western Ghats and localities of Bangalore (Gadhakar *et al.,* 1993, Rastogi *et al.,* 1997, Sunil Kumar *et al.,* 1997, Anu and Sabu 2007, and Varghese, 2008). This difference in diversity could be due to inadequate studies in Tamil Nadu. Moreover, the differences in richness could possibly result from interactions existing between the ant fauna of the surrounding vegetation and associated fauna present at that specific geographical location. A more complete and comparative study of the biodiversity of the ant fauna of the state may throw more light on this aspect.

The taxonomic structure of the myrmecofauna sampled, resembles that of Western and Eastern Ghats and other tropical regions in two ways. Firstly, many rare species and a few abundant species were collected (Malsch, 2000). Secondly, the subfamilies such as Myrmicinae, Ponerinae, and Formicinae were dominant. The Myrmicinae alone accounted for nearly 50% of the genera, species, and individuals sampled (Gadagkar *et al.,*1993, Rastogi *et al.,* 1997, Anu and Sabu, 2007, Ramesh, 2007 and Ward, 2000). However, the relative importance of the Ponerinae and Formicinae subfamilies in the ants collected, differed with that of ants collected in both the Atlantic forest and the Amazonian forest. In these two regions, the Ponerinae subfamily was significantly predominant (Majer and Delabie, 1994, Delabie *et al.,* 2000, Vasconcelos and Delabie, 2000 and Tavares, 2002).

The species accumulation curve showed increasing trend even after 50% of sampling efforts, this clearly indicates that the likelihood of getting more species were bright. This was supported by rarefaction curve (Fig. 4), which clearly indicated that, sites like undisturbed scrub jungle might provide up to 44 species of ant. Common richness indices provide rather abstract figures, thus it is appropriate to use extrapolation methods to estimate the total number of species from empirical sample that make up the community under study since complete inventories are practically impossible. Hence, Michaelis-Menten mathematical model and Coleman curve were used. Various studies have shown that estimators such as the MMMean and Coleman rarefaction are more reliable when compared to other estimators (Colwell and Coddington, 1994 and Sanjayan *et al.*, 2002).

Overall abundance pattern in different sites varied considerably due to their habitat heterogeneity and species composition. This was evident in certain sampling sites 1, 11 and 14 were common species viz., *Diacamma rugosum, Camponotus variegates, Myrmicaria brunnea, Pheidole* spp. dominated. As observed by many workers (Malsch, 2000 and Ramesh, 2007) species abundance pattern indicated a relatively small proportion of abundant species against large number of rare species.

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